*BUSINESS EQUIPMENT MANUFACTURERS ASSOCIATION

235 EAST 42nd STREET, NEW YORK 17, NEW YORK • MUrray Hill 7-5969

DATA PROCESSING GROUP

Subcommittee X3-2 - Character Sets and Data Formats of
ASA X3 Sectional Committee on Data Processing Standards

THIS WAS IT!

MINUTES

Tenth Meeting, September 14th and 15th, 1961
BEMA Headquarters, New York, N. Y.

SUMMARY

Mr. Liggett resigned. Mr. Macon was appointed Chairman pro tem. A 7 level code was developed as the basis for a standards recommendation. An outline for report recommending the code was developed and ad hoc committees were formed to complete the various sections. Next meeting November 8, 9 & 10, BEMA Headquarters.

G. M. WILSON
SEP 28 1961
ANS'D
REF'D

NMAH 310/2

*Formerly Office Equipment Manufacturers Institute

X3-2 Sub-Committee
on
Character Sets & Data Formats
of the
American Standards Association
X3 Sectional Committee
Sponsored by
B.E.M.A.

September 19, 1961

MINUTES

MEETING OF SEPTEMBER 14th AND 15th

1 MEMBERSHIP & ATTENDANCE

1 1

Members	Corporation	September 14	September 15	Alternate	September 14	September 15
John Auwaerter	Teletype Corp.	x	x			
Leon Bloom	NCR	x	x			
T. H. Bonn	Remington Rand	x	x	D. Utman		
L. L. Griffin	Navy Department	x	x			
R. Gryb	AT&T Company			J. Booth	x	x
H. Kleinberg	RCA			H. Spielman	x	x
I. C. Liggett	IBM	x				
Maj. W. Luebbert	West Point	x				
C. E. Macon	Burroughs Corp.	x	x			
R. W. Reach	Minneapolis Honeywell	x	x			
H. J. Smith, Jr.	IBM	x	x	R. Bemer	x	x
H. Tholstrup	Friden Inc.	x	x			
Allen Whitman	Bell Tele Lab	x	x			

Observers & Guests

Dr. J. Barker	
H. D. Vogt	AT&T Company

1.3 Mr. Liggett's resignation was accepted with regret.

2. DOCUMENTS DISTRIBUTED

2.1 Ad Hoc Committee: L. Bloom, C. Macon

2.1.1 Rough draft introduction to Final Report

2.1.2 Specific Criteria (rough draft)

2.1.3 Chart indicating comparison of several versions of special character quadrants

2.2 Chart - Analysis of typewriter keyboards - Smith

3. Dr. Barker announced the resignation of Mr. Bright and the extended leave of absence being taken by Mr. Howard and that he (Dr. Barker) would be assuming their duties temporarily.

4. Mr. Liggett announced that he was resigning from the Committee.

5. Chuck Macon was unanimously elected Chairman pro tem and Leon Bloom Secretary pro tem. The Committee also recommended that Mr. Macon be appointed permanent Chairman and that R. E. Utman be appointed permanent Secretary.

5.1 It was noted that reports on the Government X3-2 meetings had not as yet been received from:

W. Luebbert
J. Booth
J. Auwaerter

All indicated that their reports would be submitted within two weeks. It was decided that the reports would be distributed without prior Committee approval.

6. John Booth gave a preliminary report on burst noise in transmission system. A more extensive report will be forthcoming at the next meeting.

7. Motion was passed to try to design a 7 bit set with due consideration for the requirements of an 8 bit set and the keyboard.

MINUTES
TING OF SEPTEMBER 14 & 15

September 19, 1961

The documents, 2.1 and 2.2 were reviewed and approved in principle.

The code structure and specific character assignments were discussed in great detail and resulted in the identification of the coded character set (see Fig. I) which is to be submitted to the X-3 Sectional Committee for approval.

The following points should be noted concerning the recommended set:

.1 The special characters in the alpha section were tentative.

The control characters in the transmission and terminal device control section are subject to rearrangement.

A minority dissenting opinion was expressed which will be documented in conjunction with the written ballot which will be forthcoming.

Outline of report on Committee recommendation:

The following outline was agreed upon by the Committee with the indicated people forming ad hoc committees to write up specific sections.

I. INTRODUCTION

II. X3-2 STATUS AND PLANS

III. CODE

IV. DISCUSSION

- A. Set Size
  - 1. Information Subset
  - 2. Controls
    - a. Delimeters
    - b. Transmission
    - c. Machine (producer-recorder)
- B. Set Structure
  - 1. Dense information subset

2. Useful 4 bit subset
3. Segregated control subset
4. Null
5. Escape
6. Delete

C. Character Selection

D. Control Selection

E. Character Placement

1. Influence of existing codes and standards
2. Expansion and contraction
3. Transmission considerations

F. Planned Deviation

G. Error Control

V. CONCLUSION

VI. RECOMMENDATIONS

Note: Sections I through VI are to be complete by the following ad hoc committee:

L. L. Griffin - Chairman
A. L. Whitman
T. H. Bonn
R. E. Utman
H. J. Smith

APPENDIX

Macon	Statement of Problem - What is interchange?
Smith	Criteria
Bloom & Bemer	Examples of Planned Deviations
Spielman & Reach	Data Manipulation

September 19, 1961

MINUTES
MEETING OF SEPTEMBER 14 & 15

Booth & Whitman Griffin	Transmission
Tholstrup & Auwaerter Bloom & Macon	Terminal Devices (Data producers & recorder)
Luebbert	Other Codes & their Criteria
Whitman & Other members as required	Glossary

11. The schedule for future work is:

11.1 Progress Report to X-3 on September 28

11.2 Completion of assignments by ad hoc groups. Final drafts to be in to the Chairman by October 20. Copies to members by October 27th.

11.3 Letter ballot on recommended code to be issued by September 29. Replies to be in by October 6.

11.4 Meeting of X3-2, November 8, 9, 10 at BEMA Headquarters to complete and approve final report.

12. NEXT MEETING November 8 - 9 - 10

BEMA Headquarters

235 East 42nd Street
New York, N. Y.

Telephone: MUrrayhill 5-7969

Leon Bloom
Secretary Pro Tem

LB/CEM/ea

note different punctuation order in Reading version

Preliminary Draft - 7 LEVEL CODE FOR INFORMATION INTERCHANGE

					B7	0				1			
					B6	0		1		0		1	
	B4	B3	B2	B1	B5	0	1	0	1	0	1	0	1
0	0	0	0	0		Null	8 Data Delimiters	ƀ	0	!	P	Answer Back	☒
1	0	0	0	1		R. U.		'	1	A	Q	☒	
2	0	0	1	0		☒		"	2	B	R		
3	0	0	1	1		☒		<	3	C	S		
4	0	1	0	0		W R U		>	4	D	T		
5	0	1	0	1		Motor 1 Stop		$	5	E	U		
6	0	1	1	0		Ver Tab		%	6	F	V		
7	0	1	1	1		Horz Tab		&	7	G	W		
8	1	0	0	0		Feedout	☒	(	8	H	X		
9	1	0	0	1		Trans Start		)	9	I	Y		
10	1	0	1	0		Bell		:	;	J	Z		
11	1	0	1	1		Rec 1 ON		*	+	K	#		
12	1	1	0	0		Rec 1 OFF	L. F.	/	?	L	@		
13	1	1	0	1		Rec 2 OFF	C. R.	-	=	M	≠		
14	1	1	1	0		Rec 2 ON	U. C.	,	←	N	≤		Escape
15	1	1	1	1		Trans Stop	L. C.	.	↑	O	≥		Delete

FIG. 1

note ^D is WRU, ^J is bell

☒ - To be assigned

B_1 = Lowest order Binary Bit

B_7 = Highest order Binary Bit

< and > are as in BSI 7-bit

␢	0		P
NA	1	A	Q
NL	2	B	R
FF	3	C	S
TB	4	D	T
BS	5	E	U
SO	6	F	V
SI	7	G	W
(	8	H	X
)	9	I	Y
%	10	J	Z
£	11	K	
?	½	L	
&	+	M	
*	–	N	ESCAPE
/	.	O	DELETE

␢ = Word Separator (Space)

NA = Not Assigned

NL = New Line (Line Feed)

FF = Form Feed

TB = Horizontal Tab

BS = Backspace

SO = Shift Out (Lower Case)

SI = Shift IN (Upper Case)

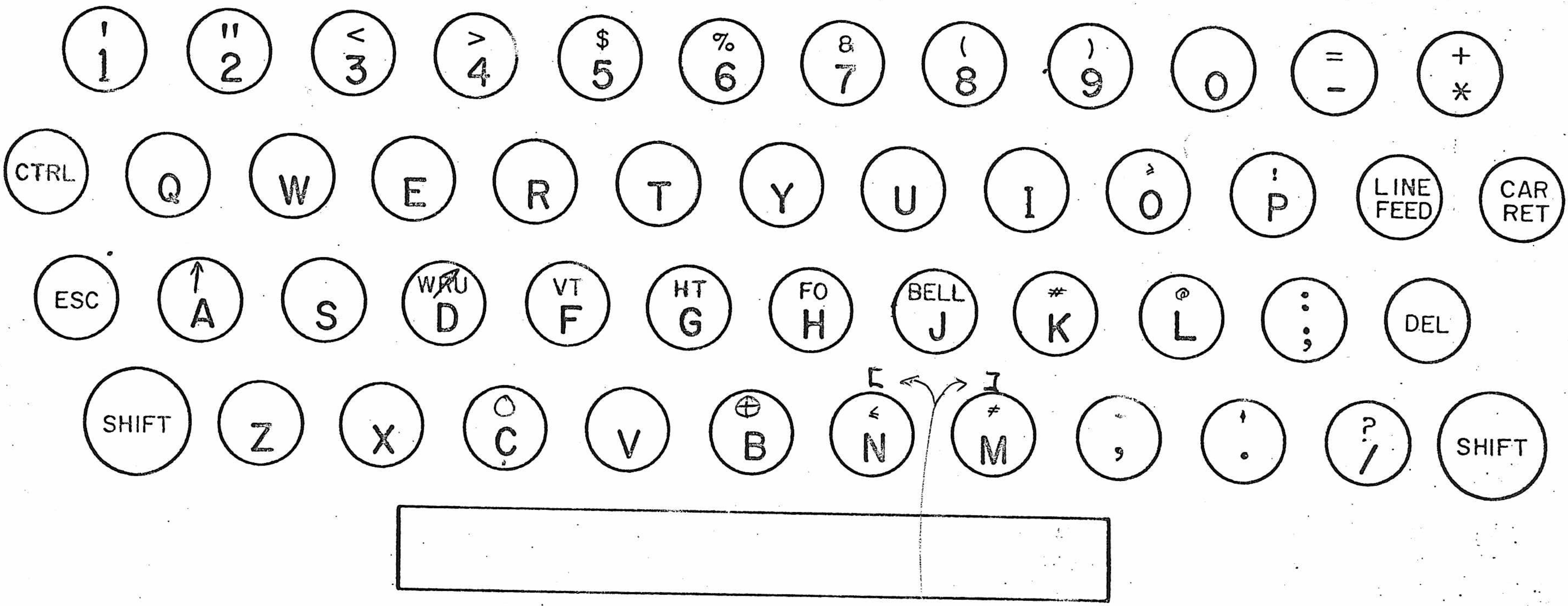
PROPOSED B.S.I. CODE PER R. BEMER, I.B.M.

JBBooth - September 26, 1961

NMAH 310/2

BEMA CODE STANDARD

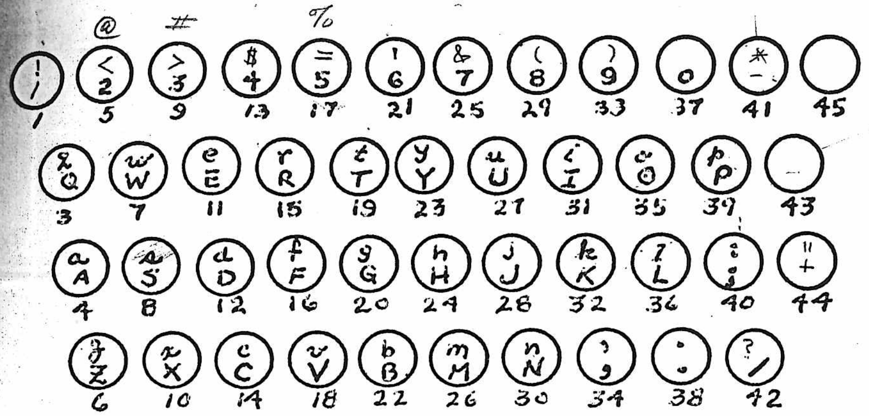
	000	001	010	011	100	101	110	111
0000	Null-Idle	Data Delimiter	Б	0	!	P	Area of Planned Deviation	Area of Planned Deviation
0001	Vert. Tab		'	1	A	Q		
0010	Revr. 1 ON		"	2	B	R		
0011	Rcvr. 1 OFF		<	3	C	S		
0100	~~Who Are You~~		>	4	D	T		
0101	~~TD Stop~~		$	5	E	U		
0110	~~FD Out~~		%	6	F	V		
0111	~~H. Tab~~		&	7	G	W		
1000	Motor Off		(	8	H	X		
1001	Rcvr. 2 ON		)	9	I	Y		
1010	Bell		:	;	J	Z		
1011	Rcvr.2 OFF		*	+	K	#		
1100	TD Start	LF	/	?	L	@		
1101	Are You	CR	-	=	M	≠		
1110		UC	,	←	N	≤		ESC
1111		LC	.	↑	O	≥		DEL-IDLE


! 1
" 2
< 3
> 4
$ 5
% 6
& 7
(8
) 9
0
= -
+ *
CTRL
Q
W
E
R
T
Y
U
I
≥ O
! P
LINE FEED
CAR RET
ESC
↑ A
S
~~WRU~~ D
VT F
HT G
FO H
BELL J
# K
@ L
: ;
DEL
SHIFT
Z
X
○ Ç
V
⊕ B
[
]
≤ N
≠ M
,
.
? /
SHIFT

per Bemer

Summary of Letter
J.M Conant (ET Prod. Plan.) to H. J. Smith jr.
7/14/61.

1. Key positions normally touch typed.



Note: These positions should be maintained on I/O Keyboards. The ; and / may be exceptions to this rule.

2. Other common assignments.

Position	U.C.	L.C.	Position	U.C.	L.C.
5	@ "	See Keyboard Layout	42	?	See K'bd.
9	#		1	[	]
13	$		41	—	−
17	%			*	1
21	¢		45	+	=
25	&		43	°	!
29	* ? ½			!	1
33	(			¼	½
37	)			"	'
40	:		44	"	'
34	,			—	−
38	.				$

3 Remarks.

a) Changes cause reduced efficiency and increased errors until new Keyboard is learned.

b.) Particularly frustrating conditions result when:

1. Typist must alternate between two different Keyboards
2. Typist is an older person
3. Typist is highly proficient on present Keyboard arrangement.

Memorandum

FOR ALL INTERNAL COMPANY CORRESPONDENCE

1128 628

DATE September 19, 1961

TO W.W. Finke

FROM R. F. Clippinger

SUBJECT Possible Imminent Standards

COPIES TO:
J.W. Anderson
R.M. Bloch
J.J. Eachus
R.W. Reach
O.H. Rye
R.E. Wilkins

X3.1

As pointed out in Joe Eachus's memo of September 18, X3.1 appears close to recommending a single font set for decimal digits and a few special characters. Joe was originally concerned that this set might cause us serious problems with the high speed printer.

In the meeting this morning, attended by Owen Rye, Joe Eachus, Bob Wilkins and myself, Bob said that he felt that we could handle this font set with reasonably minor modifications to the printer but that, before he took this position firmly, he would like to try it out which he felt he could do reasonably easily. The main question discussed at the meeting was whether Honeywell should enter a dissenting opinion if and when X3.1 decides to pass along the recommended standard to X3. The tentative conclusion was that this would not be necessary and Joe has written a memo (copy attached) to find out whether anyone else in Honeywell has any compelling reasons for dissenting. In general, Joe felt that these characters are more resolvable than most that had been proposed and that the optical scanning end of our business would profit from the adoption of the standard.

X3.2

Roy Reach reports that X3.2 has made major progress toward agreeing on a character set containing 128 characters, most of which will be determined by early November and probably passed along to X3 as a recommended standard. This set will contain a 24 character subset and perhaps several 16 character recommended sets, but, surprisingly, from the point of view of Teletype, which will probably soon go from a five-bit to an eight-bit set, there will be no recommended 32 character set in it. It is also noteworthy that this set which X3.2 may recommend is incompatible with the Defense Department's Field Data set. X3.2 tried to negotiate with Field Data but they are adamant.

Roy has prepared a memo summarizing the current situation and attached is a memo requesting any dissenting opinions.

RFC

R. F. Clippinger

RFC:ml
encls.

CBI 67 /1/1 ?

Memorandum

FOR ALL INTERNAL COMPANY CORRESPONDENCE

1123 053

DATE September 19, 1961 COPIES TO:

TO All Division Heads and all
Engineering Department Heads

FROM J. J. Eachus

SUBJECT ASA Standard Font for Optical Character Recognition

REF: Memo, September 18, by J.J. Eachus

As a result of discussions with Bob Wilkins, Dick Clippinger, and Owen Rye, it at present seems expedient to subscribe to the tentative character shapes and sizes published.

On ten October, there will occur the last reasonable opportunity to demur, and consequently any one with soundly based objections should contact me by that time.

RFC for JJ Eachus
J. J. Eachus

JJE:ml

Memorandum

FOR ALL INTERNAL COMPANY CORRESPONDENCE

1120 655

DATE September 21, 1961
TO W. W. Finke
FROM R. F. Clippinger
SUBJECT X3.2 - Standards

COPIES TO: J.W. Anderson
R. M. Bloch
J.J. Eachus
R.W. Reach
O.M. Rye
R.E. Wilkins

The attached memo from Roy Reach describes a character set which may be recommended for a standard to X3 by early November. If such a standard were adopted, it would have many implications that are the same for us as for other computer manufacturers, and perhaps certain specific ones for us. It will certainly be worth some sacrifices to achieve a recognized standard. On the other hand, it is well for us to attempt to estimate the cost to us of changing at some time to such a recognized character set. This memo is, therefore, a call for dissenting opinions accompanied by positive suggestions where possible. If Honeywell does not register any dissent via Roy Reach on X3.2 or R. F. Clippinger on X3, this character set has a good chance of being adopted in the near future.

It should be observed that X3.2 is not taking any position at the moment as to collation sequence and that one of the participants (IBM) is thinking in terms of using this character set with the collation sequence, which moves the digital subset behind the letters of the alphabet. Nevertheless, the adoption of this character set certainly has some bearing on collation sequence.

The Marketing Division should compare the six-bit subset obtained by dropping bit a6 with the character set currently in use on our high speed printer, and consider the implications, bearing in mind the November deadline for dissensions.

RFC

R. F. Clippinger

RFC:ml

encl.

Memorandum

FOR ALL INTERNAL COMPANY CORRESPONDENCE

DATE September 18, 1961

TO R. F. Clippinger

FROM R. W. Reach

COPIES TO:
W.W.Finke
J.E.Smith
C.F.Dubay
J.W.Anderson
M.A.Antman
J.J.Eachus
E.J.Dieterich

SUBJECT X3-2 Meeting -- September 14 and 15

The X3-2 Subcommittee on Character Sets and Data Format met on September 14 and 15 in New York. Drafts of all documents generated by X3-2 in setting up a criteria for a standard Character Code set were reviewed; also, assignments were given each member to provide more detailed, finished write-ups of the various documents required to support a recommendation of a standard Character Code. I have been assigned a write-up showing data manipulation consideration in selecting a standard Character Set. The Committee is attempting to prepare a report to X3 for a recommended standard Character Set by early November.

Votes were taken on the Character Set to be printed in this report. All members were in agreement except Howard Smith of IBM who had personal objections to some details and would not vote for anything that did not include each point he desired. However, Mr. Bob Bemer of IBM was present as an observer and indicated that IBM would be very pleased with this proposed Character Set and would go along with it. However, IBM would not pioneer the use of this or any other character set. (It is to be noted that Mr. Bemer's position in IBM is such that his opinions have much more weight in IBM than Mr. Smith's opinion. Mr. Smith is a very opinionated individualist who appears unable to compromise his personal stand to any degree whatsoever, in spite of his Company's stand or the Committee's stand.) A copy of the Code set as voted is attached to this report.

It is to be noted that Irving Liggett, who was Chairman of X3-2 and IBM's representative on X3, has resigned from IBM, X3, and X3-2. Dr. Barker, who is acting Director of DPG in BEMA replacing John Howard who is on a leave of absence, and Herb Bright who resigned, named Charles Bakin of Burroughs as Acting Chairman of X3-2 pending the X3 meeting when a new Chairman will be named. The members of X3-2 passed a resolution supporting Mr. Bakin's permanent appointment as Chairman.

The next meeting of X3-2 is set for November 8 and 9 in New York.

RWR:S

R. Reach

September 15 Proposed Standard Code Set X3-2

Seven Bit Standard

0	0	0	0	1	1	1	1 a7	
0	0	1	1	0	0	1	1 a6	
0	1	0	1	0	1	0	1 a5	a4 a3 a2 a1
Null *	↑	Space	0	@	P	Ans.Back	p	0 0 0 0
V.tab		!	1	A	Q	a	q	0 0 0 1
Rec #1 on	8	≤	2	B	R	b	r	0 0 1 0
Rec #1 off	Data	≥	3	C	S	c	s	0 0 1 1
WRU	Delimiters	$	4	D	T	d	t	0 1 0 0
Motor Stop		'	5	E	U	e	u	0 1 0 1
Feed out		"	6	F	V	f	v	0 1 1 0
H tab	↓	&	7	G	W	g	w	0 1 1 1
		(	8	H	X	h	x	1 0 0 0
Rec #2 on		)	9	I	Y	i	y	1 0 0 1
Bell		*	;	J	Z	j	z	1 0 1 0
Rec #2 off		?	/	K	[	k		1 0 1 1
[illegible] start	[illegible]	#	+	L	[illegible]	l		1 1 0 0
[illegible]	[illegible]	=	-	M	×	m		1 1 0 1
	[illegible]	,	←	N	[illegible]	n	Escape	1 1 1 0
	[illegible]	.	↑	O	[illegible]	o	Del/Idle	1 1 1 1

* Communication Idle

September 18, 1961

R. W. Reach

Six Bit Subset (Drop Bit a6)

0 0	0 1	1 0	1 a7 1 a5	a4	a3	a2	a1
Space	0	@	P	0	0	0	0
!	1	A	Q	0	0	0	1
<	2	B	R	0	0	1	0
>	3	C	S	0	0	1	1
$	4	D	T	0	1	0	0
'	5	E	U	0	1	0	1
"	6	F	V	0	1	1	0
&	7	G	W	0	1	1	1
(	8	H	X	1	0	0	0
)	9	I	Y	1	0	0	1
:	;	J	Z	1	0	1	0
?	/	K	#	1	0	1	1
*	+	L	%	1	1	0	0
=	-	M	≠	1	1	0	1
,	←	N	≤	1	1	1	0
.	↑	O	≥	1	1	1	1

SPECIFIC CRITERIA

1. A single standard coded character set is required to facilitate the interchange of information between systems and between systems and associated equipments.

    Machines which use code sets larger or smaller than the standard set are expected to expand or contract the data to the standard interchange format before transmission to or recording interchange media for other machines.

2. The standard set is to be so structured that the expansion to a useful larger set or contraction to a useful smaller set can be achieved in a simple and logical manner.

3. It is expected that the published standard will include the number of illustrative useful subsets and supersets of the standard code set.

3. The code for all symbols included in the sets is to include the same number of bits.

    This requires elimination of morse and similar codes.

4. The number of bits in a standard code shall be no more than is required to contain the alphanumeric characters and commonly encountered punctuation and other special symbols and those controls required for information interchange.

    This objective reflects the thought that the code should be sufficiently large to handle the vast majority of data interchange without unnecessary burdening all systems with the requirement of large and highly sophisticated systems. A code which satisfies this requirement will be useful for the majority of processors as well as the vast majority of input/output devices.

5. A useful four-bit numeric subset is to be contained within the standard set. A four-bit subset is to include the digits 0 through 9 and six specified related symbols.

6. The standard set is to contain a pure information subset including the alphanumeric characters and commonly encountered punctuation and special symbols.

This requirement will result in 2^n characters all valid. Such a dense binary subset will have 2^n graphics assigned and each printable.

7. Within the standard set, each character and corresponding code will stand by itself and not depend on characters in the string for interpretation.

   That code (all codes) identified as a mode shift or escape function will meet this condition and will be considered an initial departure from the standard set. A numeral shall be so coded that the least four significant bits shall be the binary coded decimal and form of the decimal digits which the code represents.

8. The standard set shall be so structured that the binary coded decimal codes for 10 and 11 are assigned symbols and should be included with the numerals upon collapse to a four-bit subset.

   This allowance is to provide for adaption to the code to foreign problems. Placement may be different from numerics.

9. The English alphabet shall be contiguous, A through Z, with the smallest binary number of this code area representing the letter A.

   This characteristic is to be useful in alphabet collation and will avoid difficulty sometimes encountered when symbols placed within the alphabetical field are assigned a collating significance.

10. Allowance is to be made for planned deviations from the standard set to contain up to 32 alphabetical characters.

    This provision will allow for incorporation of foreign alphabets.

11. The minimum control codes required to implement criterion #1 above are to be included.

12. The set will contain an "escape" character and code.

13. The simplest logical relationship possible shall exist between the binary sequence and the collating sequence and, if possible, the two shall be identical.

14. The "word separator" must collate low.

15. Punctuation and special symbols used in the ordering of information collate low with respect to the alphabet and numerals.

16. It shall be an objective to group the symbols by characteristics.

    By this it is meant that each class of symbols will be contiguous and lie wholly within a given code area. For example, punctuation marks should lie in one area, relational operators in another and shorthand notation (such as $ and %) will lie in still another area.

17. The special symbols will be so placed in the set so as to simplify their code generation by typewriters and similar keyboard devices.

    This objective requires that the codes assigned to graphics which appear on the same key top in a "normal" office typewriter should have a uniform and simple relationship.

18. The set shall include the COBOL character set.

19. The set shall be so organized that the simplest possible test shall be adequate to distinguish and identify the basic alphabet, numerics, and special symbol subsets. Assignment of important meaning to codes which are likely to be inadvertently generated in the data processor or transmission is to be avoided.

    Thus, the all zeros character, which can be generated on an open line or during transmission interruption in some communication systems, will probably not lie within the dense binary subset. Similarly, the all ones code commonly used for the "delete" function in paper tape, will be treated specially.

20. The set is to contain an "idle" or "blank" function (the presence of no information).

21. Consideration will be given to the inclusion of suitable means for data delimiting and format identification in detail in the standard set.

22. The set shall include planned deviations and feature assignment possibilities.

23. Error control shall not be part of the standard set. It will be defined in the media standards.

John F. Auwaerter

What Should Be the Standard 7-Bit Code Set for Communications and Data Processing? - A Plan W Proposed by A. L. Whitman

September 26, 1961

This proposal is a counter-proposal to the majority recommendation of the BEMA X3-2 Subcommittee for a standard 7-bit code (128-character set) for the interchange of information between data-processing systems and between systems and associated equipment. This proposal, named Plan W for convenient reference, represents the personal views of the writer and not in any sense a corporate position.

The basis for the minority report is, quite simply, a difference of opinion about the relative importance of four primary objectives. Since many of the implications of these objectives are contradictory, no compromise can fit all of them. The choice as to which kind of results are most desirable leads to certain principles for constructing the code.

The current decision on the choice of a code revolves around four principal objectives, as follows:

1. A keyboard as much like a "standard" electric typewriter keyboard as possible.
2. Compatibility with the present Department of Defense (DOD) military standard known as MIL-STD-188A.

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3. Ability to use the code in data processing machines without translation or conversion.
4. Compatibility with International Standards, at this time particularly European.

The differences between the majority report and this minority report result from the following different opinions on orders of priority of the four principal objectives:

Plan W	Committee Plan*
1. Keyboard	1. Data Processing
2. Dept. of Defense Code (DOD)	2. International
3. International	3. Keyboard
4. Data Processing	4. DOD Code

* The committee report does not explicitly mention this order of priority. However, for practical purposes, the design as given reflects this order of importance.

The choice between the two orders of priority is a matter of opinion and individual judgment. So much depends on speculation as to what might happen in the future that a solid determination is not possible.

Conclusion

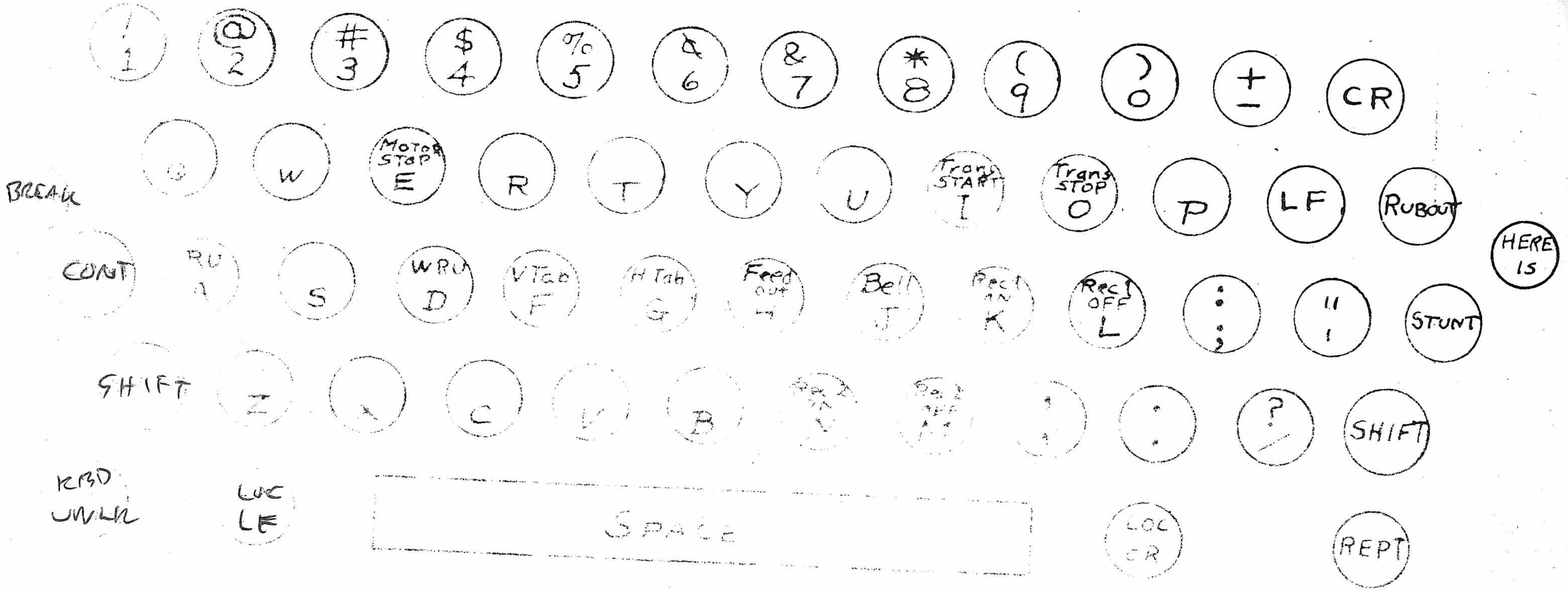
For the reasons discussed below, the writer is of the opinion that the code to be standardized should be chosen with primary weight given to the requirements of the typewriter-like keyboard, and of compatibility with the Department of Defense Code. Plan W, as shown by Table 1, with the keyboard of Fig. 1, is recommended for adoption.

Proposed 7-Bit Code Assignments

Plan W

	000	001	010	011	100	101	110	111
0000	Blank	↑ Lower Case Alphabet ↓		Rec 1 ON	Ansbk	K	)	0
0001				Rec 1 OFF	UC	L	!	1
0010				Rec. 2 OFF	LC	M	@	2
0011				Rec. 2 ON	LF	N	#	3
0100				Trans STOP	CR	O	$	4
0101					Space	P	%	5
0110	↑ Reserved for Lower-Case Alpha ↓		RU		A	Q	¢	6
0111					B	R	&	7
1000				↑ 8 Data Delimiters ↓	C	S	*	8
1001			WRU		D	T	(	9
1010			Motor STOP		E	U	"	'
1011			V Tab		F	V	:	;
1100			H Tab		G	W	?	/
1101			Feedout		H	X	+	—
1110			Trans Start		I	Y	,	STUNT
1111			Bell		J	Z	.	RUBOUT
Octile	1	2	3	4	5	6	7	8
	← Controls →				← Basic 64 Set →			
	C	C	C	C	A	Z	S	D

SEP 25 1961



PROPOSED 4-ROW KEYBOARD

To Go with 7-Un[illegible]

Plan W

Fig. 1

Notes:

1. SHIFT key changes Bit
from Mark to Space f
upper keytop graphi

2 CONT key inverts Bit
5 & 6 for upper keyto
controls over alpha
letters.

IBM

590 Madison Avenue
New York 22, N. Y.
Telephone: PLaza 3-1900

International Business Machines Corporation

28 September 1961

To Members of X3.2

Gentlemen:

Attached are some figures used to describe the X3.2 set to IBM. You may find them useful in documentation and they are offered for this purpose.

You may recall my saying at the meeting that I couldn't think of any other characters for the vulnerable positions in the alphabetic area. The three characters shown in red in Figure 1 are what I would have suggested if my memory had been working right.

The reasons for selecting the brackets are:

1. The obviously high usage in ALGOL, as evidenced by the attached study of usage (Figure 6).

2. The obviously low usage of ≠, ≤, and ≥.

3. Brackets will be much more useful for human-to-human communication.

4. Conformity with user association (SHARE, GUIDE, et al) preference.

The reasons for selecting the reverse slash are:

1. Reverse division is a useful device in programming, particularly for continued fractions.

2. Adjoining the two types of slashes in either permutation gives a reasonable representation of the logical symbols AND and OR in ALGOL. (/\ \/)

3. User association decision.

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In addition, some secondary mnemonic significance may be obtained by the association and/or mapping to ESCAPE and DELETE. If no negative comment is forthcoming, may we assume that this change in the set is agreeable to X3.2?

Cordially yours,

RWBemer

R.W. Bemer
Alternate, X3.2

RWB/jes

B_{3-0}	000	001	010	011	100	101	110	111
0000	NULL	DATA DELIMITERS	b̸	0	!	P	ANSWER BACK	p
0001	VERT TAB		'	1	A	Q	a	q
0010	RCV 1 ON		"	2	B	R	b	r
0011	RCV 1 OFF		<	3	C	S	c	s
0100	WRU		>	4	D	T	d	t
0101	TMT STOP		$	5	E	U	e	u
0110	FEED OUT	∞	%	6	F	V	f	v
0111	HORIZ TAB		&	7	G	W	g	w
1000	MOTOR STOP		(	8	H	X	h	x
1001	RCV 2 ON		)	9	I	Y	i	y
1010	BELL		:	;	J	Z	j	z
1011	RCV 2 OFF		*	+	K	#	k	
1100	TMT START	LF	/	?	L	@	l	
1101	RU	CR	—	=	M	[	m	
1110		UC	,	-s-	N	]	n	ESCAPE
1111		LC	.	↑	O	\	o	DELETE IDLE

$$\underbrace{B_7\ \overbrace{B_6\ B_5\ B_4}\ B_3\ B_2\ B_1\ B_0}_{\text{8-BIT CODE}}$$

FIGURE 1

DR 18 SEP 61

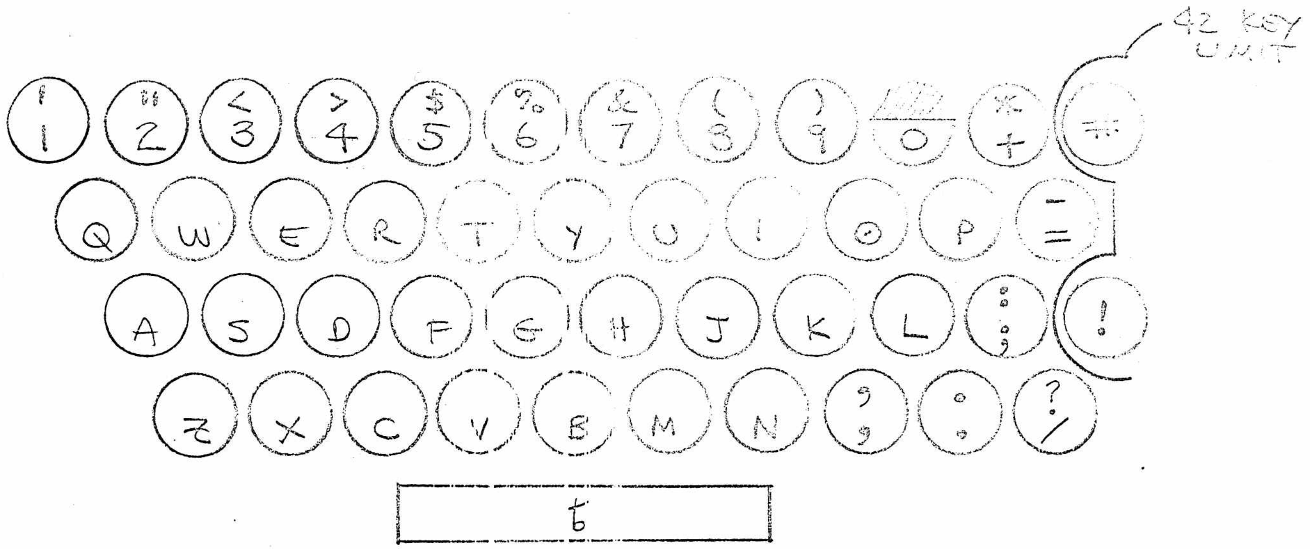

FIGURE 2

TRANSFORMATIONS LET EACH BIT POSITION (OR CONDITION) BE REPRESENTED BY:

N_B , WHERE B=0 IS LOW ORDER, B=N-1 IS HIGH ORDER, N_B^C = COLLATING FORM.

$6 \rightarrow 7$	$7 \rightarrow 6$	$6 \rightarrow 6^C$	$6^C \rightarrow 6$
$6_{4-0} \rightarrow 7_{4-0}$	$7_{4-0} \rightarrow 6_{4-0}$	$6_{3-0} \rightarrow 6^C_{3-0}$	$6^C_{3-0} \rightarrow 6_{3-0}$
$\overline{6_5} \rightarrow 7_5$		$6_4 \forall 6_5 \rightarrow 6^C_4$	$6^C_4 \forall 6^C_5 \rightarrow 6_5$
$6_5 \rightarrow 7_6$	$7_6 \rightarrow 6_5$	$6_4 \rightarrow 6^C_5$	$6^C_5 \rightarrow 6_4$

$4 \rightarrow 6$	$6 \rightarrow 4$	$4 \rightarrow 7$	$7 \rightarrow 4$
$4_{3-0} \rightarrow 6_{3-0}$	$6_{3-0} \rightarrow 4_{3-0}$	$4_{3-0} \rightarrow 7_{3-0}$	$7_{3-0} \rightarrow 4_{3-0}$
$\overline{4_3 \wedge 4_2} \rightarrow 6_4$		$\overline{4_3 \wedge 4_2} \rightarrow 7_4$	
$0 \rightarrow 6_5$		$1 \rightarrow 7_5$	
		$0 \rightarrow 7_6$	

TABLE I

Symbol Usage Study
Based on Algorithms #10 - 34 ACM Communications

Symbol	Frequency	Proposed Sets							
;	806	✓	✓	✓	✓	✓	✓	✓	✓
:=	700				✓				
,	659	✓	✓	✓	✓	✓	✓	✓	✓
[	579	✓	✓		✓		✓		
]	579	✓	✓		✓		✓		
(	334	✓	✓	✓	✓	✓	✓	✓	✓
)	334	✓	✓	✓	✓	✓	✓	✓	✓
−	266	✓	✓	✓	✓	✓	✓	✓	✓
.	217	✓	✓	✓	✓	✓	✓	✓	✓
X	173	✓	✓	✓	✓	✓	✓	✓	✓
+	155	✓	✓	✓	✓	✓	✓	✓	
:	124	✓	✓	✓	✓	✓	✓	✓	✓
=	118	✓	✓	✓	✓	✓	✓	✓	✓
/	103	✓	✓	✓	✓	✓	✓	✓	✓
<	53	✓	✓	✓	✓	✓	✓	✓	✓
>	27	✓	✓	✓	✓	✓	✓	✓	✓
≤	19								
≠	16								✓
↑	16	✓	✓	✓	✓				✓
≥	11								
÷	8								
|	8			✓		✓			✓
!	5					✓	✓	✓	✓
∨	5	✓	✓	✓	✓				
∧	2	✓	✓	✓	✓				
≡	1	✓	✓	✓	✓				
'	0	✓	✓	✓	✓	✓	✓	✓	✓
$		✓	✓	✓		✓	✓	✓	✓
¬		✓	✓	✓	✓				
?						✓	✓	✓	✓
"							✓	✓	✓
%				✓				✓	✓
#						✓		✓	✓
\						✓			
←						✓			✓

Fig. 6

PHONE CORNELIA 7-6700
TWX NO. SKO. 3454

TELETYPE CORPORATION

5555 TOUHY AVENUE
Skokie, Illinois

J. F. AUWAERTER
Director of Product Development

October 2, 1961

to W. Kaiser
of Lorenz /
Herbert Wusteny /
of
Siemens & Halske

Dear Sir:

You will recall I wrote you on September 6 outlining progress being made in this country toward the adoption of a standard intercommunication code alphabet of more than five levels. At that time I indicated a decision would have to be made for Bell System service by about the end of November.

Events are moving much more rapidly than I had anticipated. Intensive pressure to start the new service forces us to make a decision on the code alphabet by the third week of October. Heavy volume production of teleprinters based on the new code will begin in the second quarter of 1962. Naturally we would be most appreciative of receiving your comments as early as possible.

Reviewing my prior letter I found that there were several errors in it, so I have enclosed corrected pages with the changes underlined in red. While the changes do not affect the general meaning of the letter they may help to avoid confusion on some points of minor technical detail.

Two weeks ago the X3-2 Subcommittee of the ASA X3 Sectional Committee arrived at agreement on the code it would propose as an international standard. The proposal is now being documented and we expect to submit the proposal to the ASA before the end of the year. The proposal will also be submitted as a working paper to the cognizant subcommittee of ISO Technical Committee 97, though, of course, formal submission of the proposal by ASA to ISO cannot be expected until next year.

It is the present plan of the Bell System to adopt this proposed standard on the assumption that it, or a very minor modification of it, stands the best chance of gaining eventual international acceptance. The code itself as well as two possible keyboard arrangements resulting therefrom are illustrated on the attached pages.

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The code is essentially the same structure I reported to you previously. Controls lie in the left two "sticks" and the "pure information subset" is contained in the middle four "sticks." However, a minor change has been made in the intended use of the right two "sticks." You will note that in the code chart they are labeled "Area of Planned Deviation." Only two controls, ESCAPE and DELETE, are permanently located in this area. The remainder of the area is open for use as an extended set of controls, a set of special graphics or a lower case alphabet.

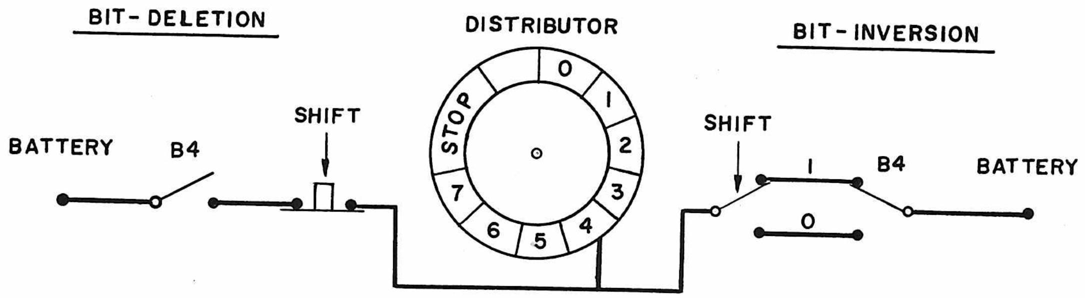
The alphabet is placed to maximize its attractiveness to the European computer industry. The symbols lying below "Z" (that is, above "Z" in binary order) are tentative and would, of course, be replaced by national alphabetical characters where more than 26 such characters are required in a particular language. The choice of symbols is one more of the many compromises that can be made between the conflicting requirements previously outlined. I feel it is a good one. You will note that the most commonly used punctuation and data organizers such as ' " ( ) : * / - and . are low in binary order to both the digits and the alphabet. This makes the code palatable to the data processors. They have permitted us both : and ; and / and ? on the same key of our typewriters.

The controls are tentatively assigned in the manner shown. You will note that all controls can be obtained from the alphabetical columns by setting bit B_6 to 0. This simplifies design of the "Control" key on the keyboard. From the keyboard illustrations you can see that the most commonly used teleprinter controls appear on the home row of keys. The "Receiver ON" and "Receiver OFF" controls are intended to be used for reperforator as well as page printer control, one pair being assigned to each type of unit, as the particular system requires. The "Who Are You" and the "BELL" are placed where you have historically put them on your keyboards.

You will note that this code can be collapsed to a six bit set useful for teleprinters. By stripping off the high order bit, the LF, CR, UC, and LC controls map into the lower portion of the 101 "stick," while the ESCAPE and DELETE map into the bottom of the digits "stick." The "Who Are You" and "BELL" would have to be mapped into the > and the : by ignoring the second high order bit. Other controls could, I believe, best be obtained in the six bit set by use of the ESCAPE mode.

By including the upper case (UC) and lower case (LC) codes in addition to the Area of Planned Deviation we will leave the way open for implementing an upper-and-lower case page printer either by means of a permutation-controlled case shift or by use of a seventh pulse shift mechanism in the page printer. To be sure that any future seventh pulse shift upper/lower case printer (with lower case alphabet coded in the Area of Planned Deviation) is completely compatible with our monocase printers (which will print out the middle four "sticks" of the code), we plan to design those monocase printers so that they will use bits B_6, B_4, B_3, B_2, B_1 and B_0 for print-out. This means they will ignore the second high order bit of the code and thus will print both the code 1000001 and the code 1100001 as an upper case "A." To achieve these results it is, of course, necessary to place the lower case alphabet in the right two "sticks" in the same way (i.e. starting at binary 1 level) that the upper case alphabet is placed in the 100 and 101 "sticks."

The keyboard which deletes bit B_4 on depression of the Shift key is illustrated as "Keyboard Based on BEMA Code with Bit-Deletion Shift." Note that such a keyboard requires a / be placed above the ? and fails to give access to the graphics # @ ≠ ⩽ and ⩾. If the Shift key causes an inversion of bit B_4 rather than a simple deletion of bit B_4, then the keyboard in the second illustration is obtained. Note that in addition to placing the ? and / in the position traditionally found in our typewriters this mechanism also permits access to the eight graphics associated with the letters K, L, M, N, O and P as well as those adjacent to the , and . symbols. To be sure that my point is clear I have drawn the circuits for bit deletion and bit inversion below:



We have not yet fully thought our way through the question of whether we will provide a parity bit in the eighth level. At the moment we feel that an even parity (if any) is preferred in order to handle 8 level blank tape and fully punched tape. You will notice that on any keyboard containing a Shift key the parity bit must be inverted (probably with a circuit as shown at the right bottom of the preceding page) in order to retain the proper parity count in the codes associated with the symbols appearing on the upper half of the keytops.

I am very sorry we have not had an opportunity to correspond at greater length on the subject before the demands of our business forced a decision. Your interest in this matter is greatly appreciated. I hope to hear from you soon.

Yours very truly

John Auwaerter

Director of Product Development

JFA:AC

Enc.

Similar Figs in Sept 6 1961 Letter

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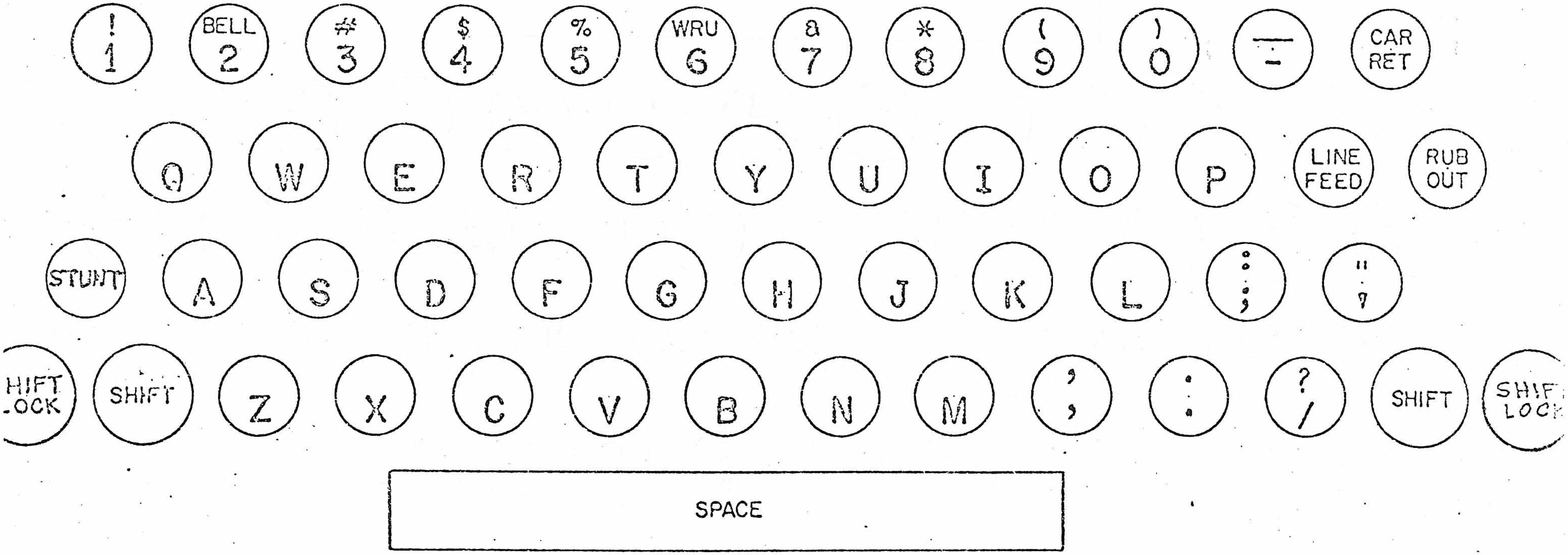
Bemer Files w/ Oct 4 1961



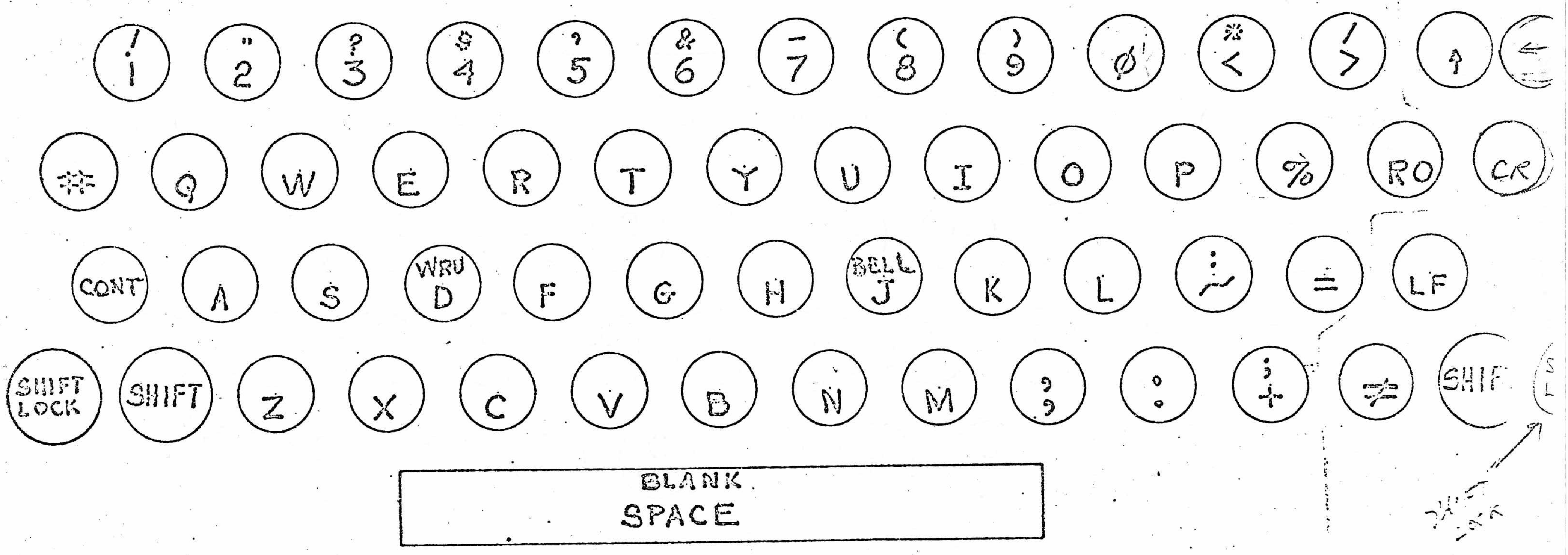
UP/LOW
TYPEWRITER KEYBOARD FORMAT
FOR TELETYPEWRITER USE

NOTES

1. SHIFT KEY TRANSMITS MOD SHIFT PERMUTATION & DELET NO. 4 BIT FROM NUMERICS A L.C. SYMBOLS

2. WRU KEY GENERATES "REQUEST FOR ANSWER BACK" OR "WHO ARE YOU" SIGNAL.

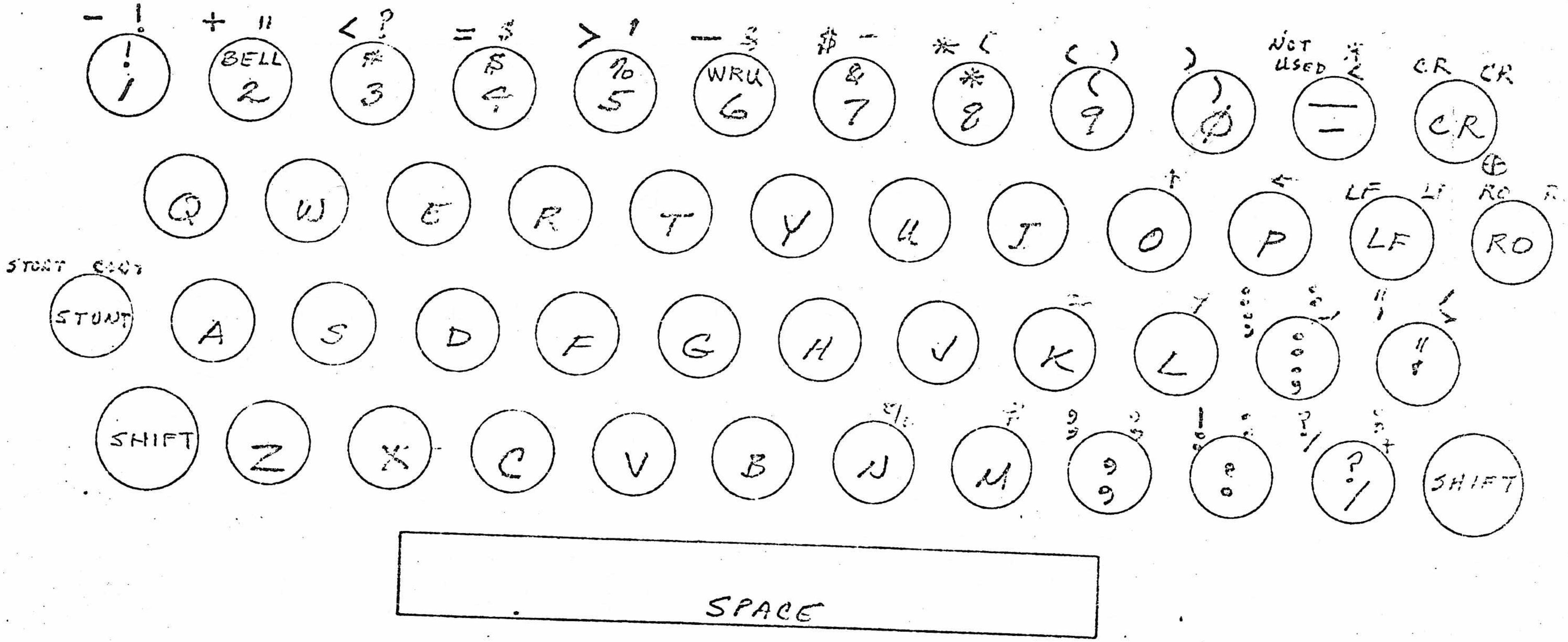
3. STUNT KEY CAUSES SUCCEEDING CHARACTER TO PERFORM A NON[illegible]INTING FUNCTION.


! 1
" 2
? 3
$ 4
' 5
& 6
‾ 7
(8
) 9
Ø
* <
/ >
↑
←
Q W E R T Y U I O P % RO CR
CONT A S WRU D F G H BELL J K L ; ≐ LF
SHIFT LOCK
SHIFT Z X C V B N M , . ; + ≠ SHIF
BLANK
SPACE
SHIFT LOCK

UP/LOW KEYBOARD BASED ON
X3-2 SUBCOMITTEE PLAN

1. SHIFT KEY T
MODE SHIFT
AND DELETES
FROM NUMER
L.C SYMBOLS

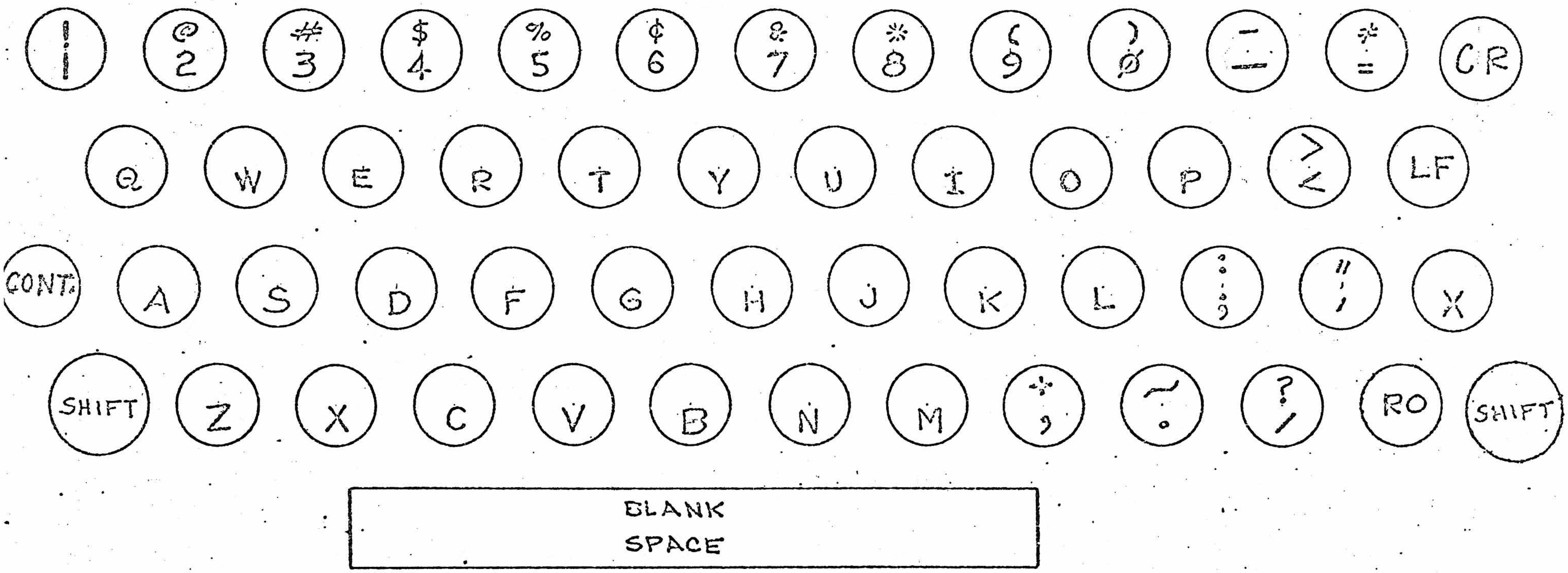
2. CONTROL KEY
BIT NO.6



— (PENCIL) INDICATES PRESENT MTWX

— (RED) INDICATES FIELDATA CODE

— (BLUE) INDICATES X3-2 PLAN

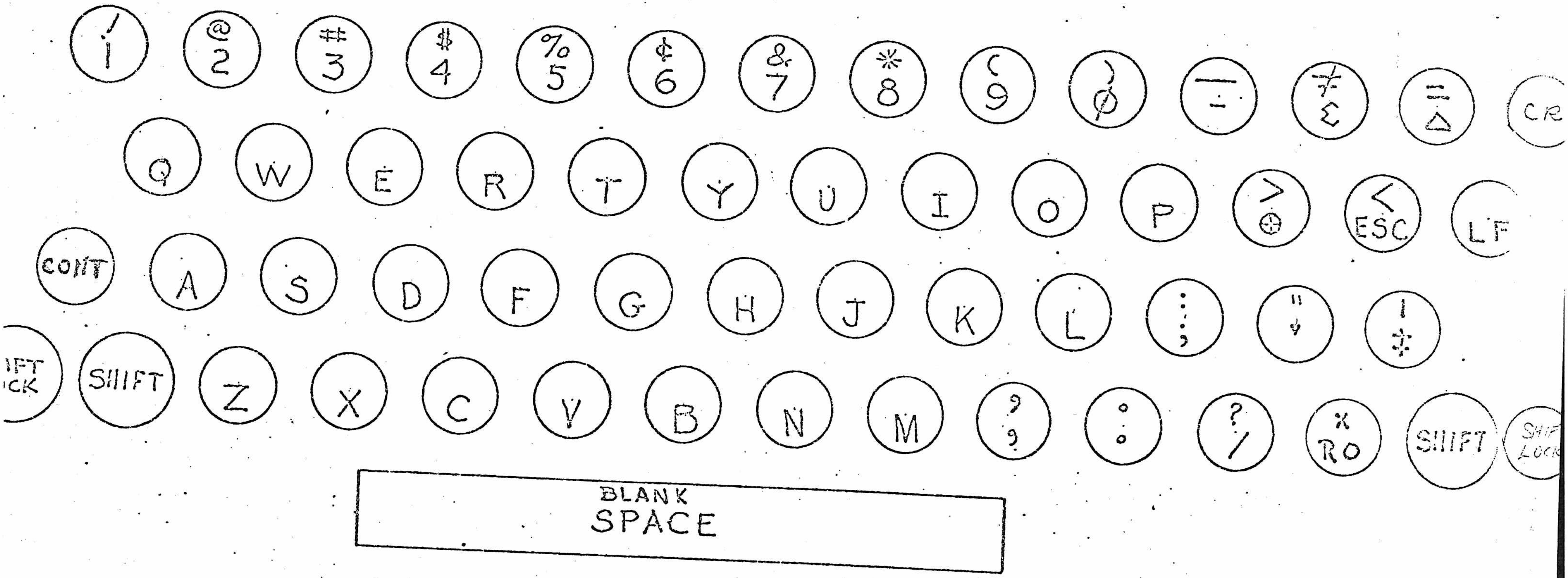


MONO CASE
KEYBOARD REPRESENTED
BY "OPTIMUM" CODE

NOTES:

1. SHIFT DEPRESSION DELETES BIT NO. 4.

2. CONTROL KEY DELETES BIT NO. 6.

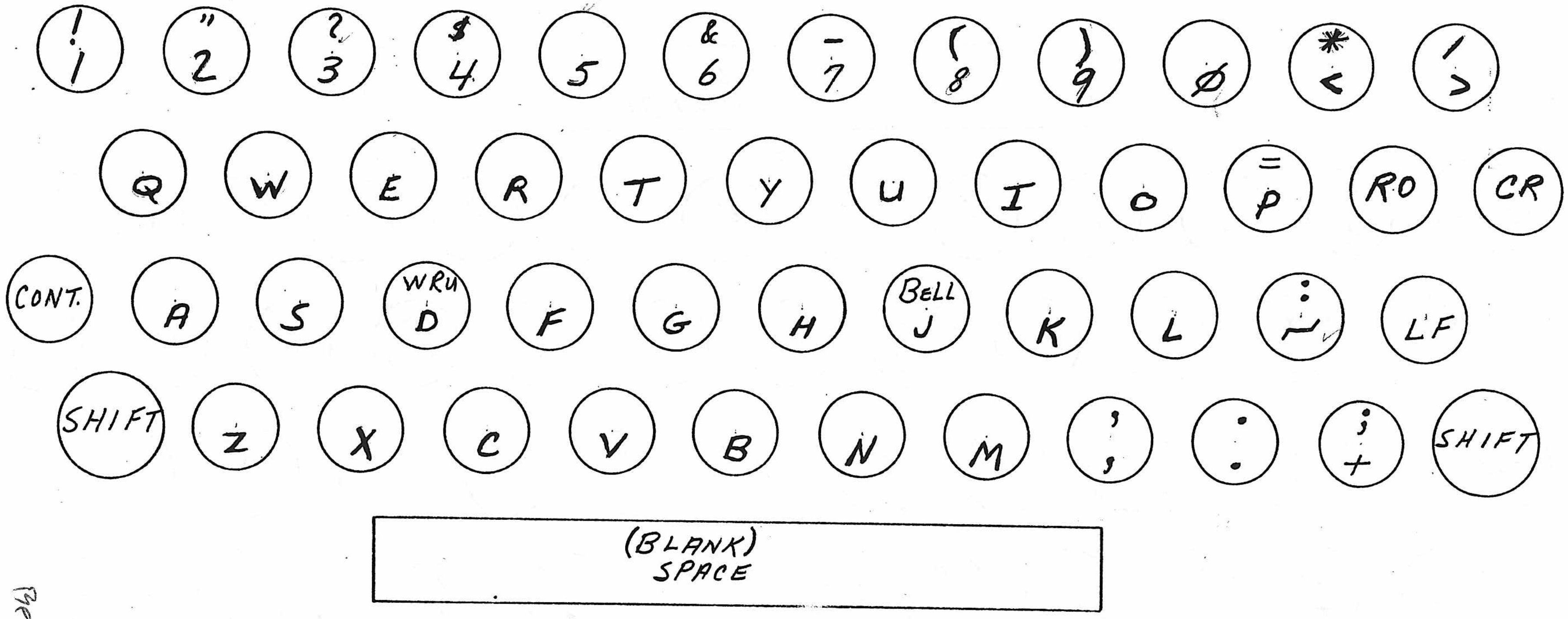


UP/LOW KEYBOARD
REPRESENTED BY "OPTIMUM" CODE

NOTES:

1. SHIFT DELETES NO
ON NUMERALS AN
DELETES NO.5 S
ALPHABET, DOES
CHANGE CODE ON

2. CONTROL DELET
N[illegible]6 BIT.



KEYBOARD LAYOUT BASED ON

X3-2 SUBCOMMITTEE PLAN BEING STUDIED

FOR INTERNATIONAL COMPATIBILITY

RO= RUB OUT OR
DELETE

BLANK (ALL Øs)
IS "SHIFT SPACE"

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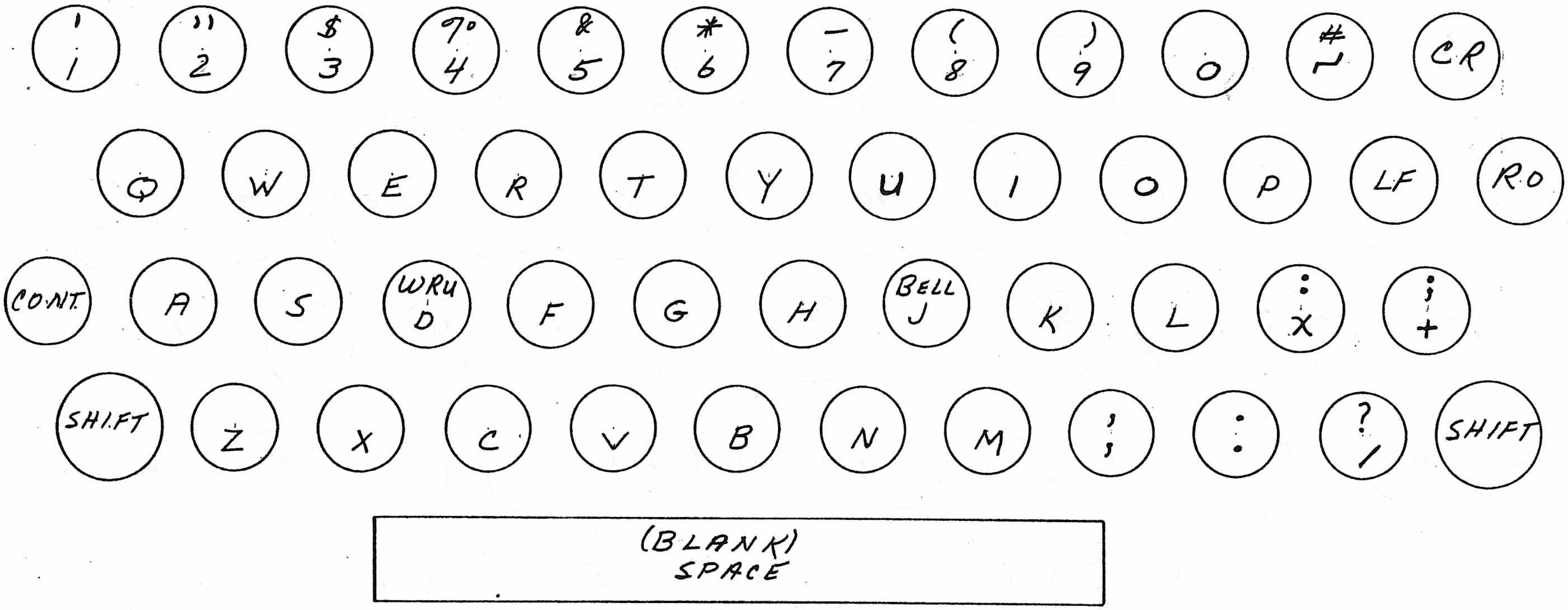
Bemer files w/ Oct V
but last page says
Aug 24 1961

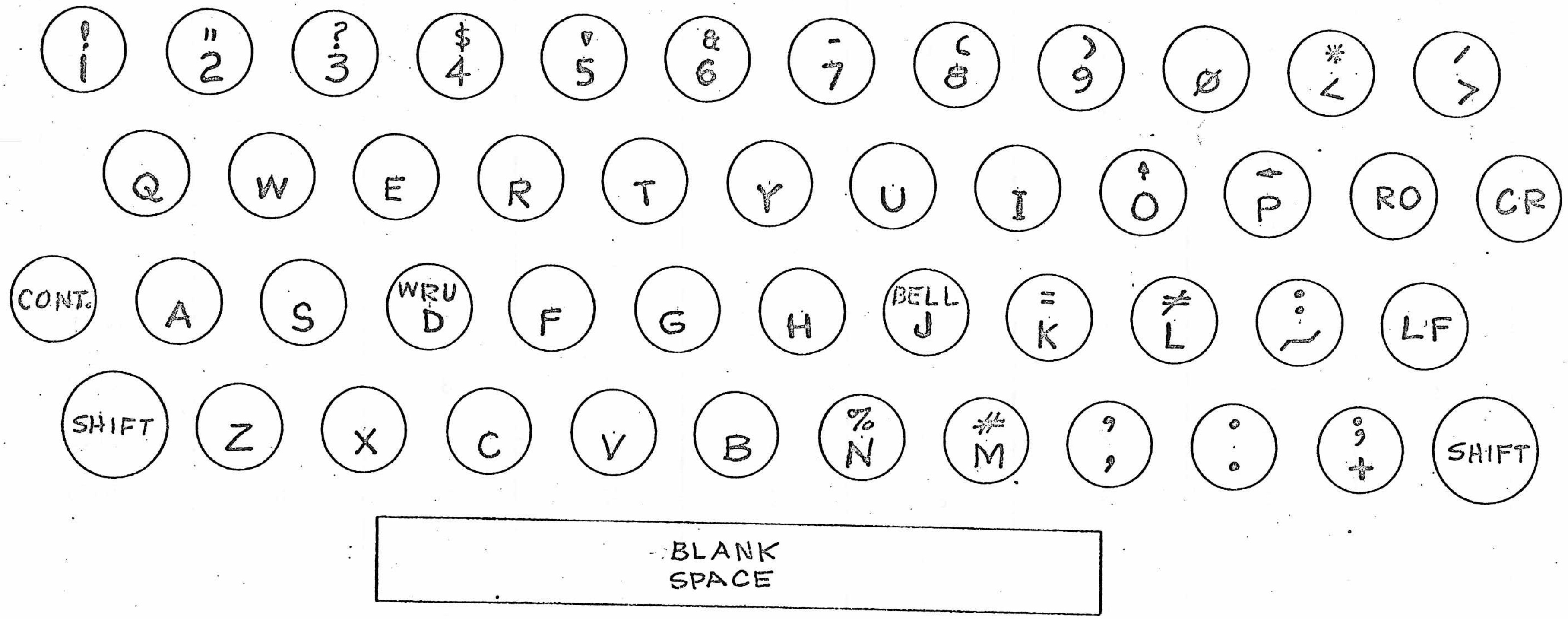


KEYBOARD BASED ON CODE SOMEWHAT
IMPROVED FOR TELEPRINTER

U.S. MILITARY
"FIELDATA" CODE

	000	001	010	011	100	101	110	111
0000					Null	K	)	0
0001					UC	L	-	1
0010					LC	M	+	2
0011	C	C	C	C	LF	N	<	3
0100	O	O	O	O	CR	O	=	4
0101	N	N	N	N	SP	P	>	5
0110	T	T	T	T	A	Q	_	6
0111	R	R	R	R	B	R	$	7
1000	O	O	O	O	C	S	*	8
1001	L	L	L	L	D	T	(	9
1010					E	U	"	'
1011					F	V	:	;
1100					G	W	?	/
1101					H	X	!	.
1110					I	Y	,	Esc.
1111					J	Z	⊕	Del.

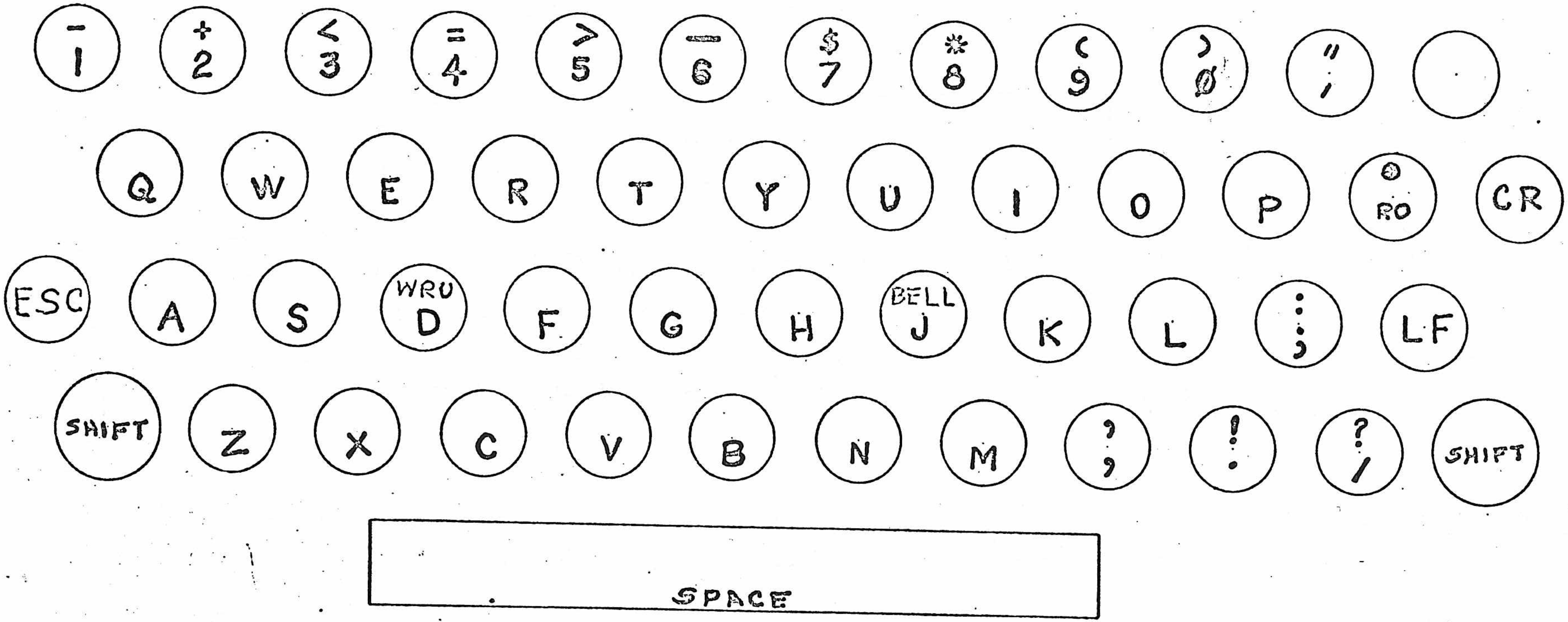
UC is Upper Case Shift
LC is Lower Case Shift
LF is Line Feed
CR is Carriage Return
SP is Space (b̄)



KEYBOARD LAYOUT BASED ON X3-2 SUBCOMMITTEE PLAN

NOTES:

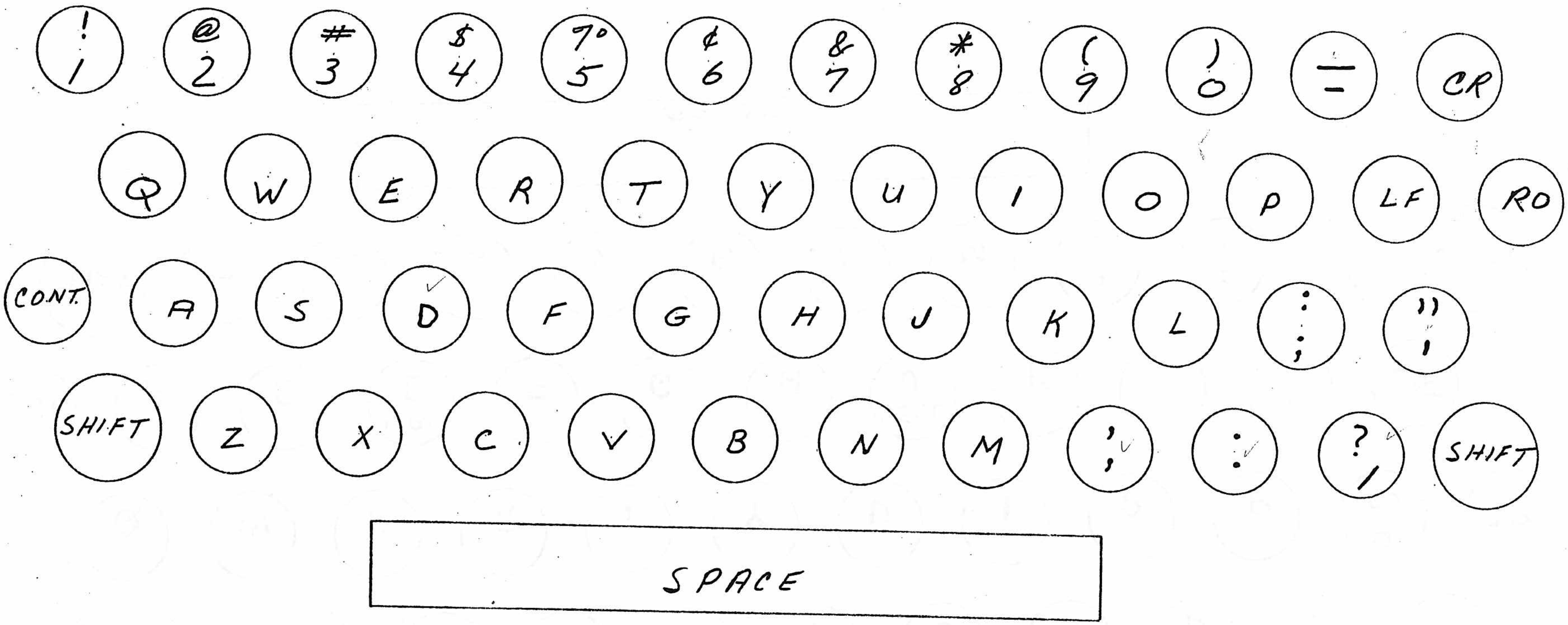
1. DEPRESSION OF SHIFT KEY DELETES BIT NO. 4.
2. DEPRESSION OF CONTROL KEY DELETES BIT NO. 6.



KEYBOARD LAYOUT BASED ON
FIELDATA CODE

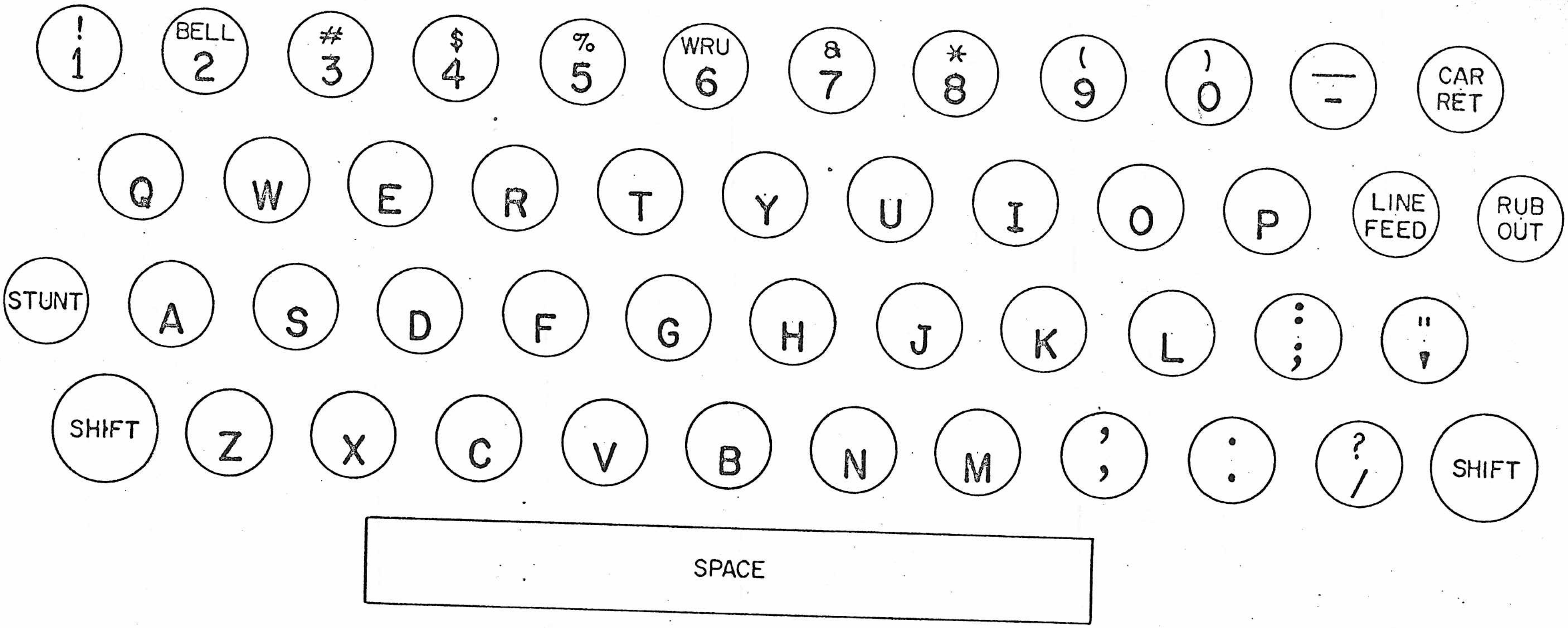
NOTES:

1. SHIFT KEY DELETES NO. 4 BIT WHEN DEPRESSED



TYPEWRITER KEYBOARD

FOR TELEPRINTER USE



TYPEWRITER KEYBOARD FORMAT FOR TELETYPEWRITER USE

NOTES

1. SHIFT KEY DELETES BIT NO. 4 WHEN DEPRESSED.
2. WRU KEY GENERATES "REQUEST FOR ANSWER BACK" OR "WHO ARE YOU" SIGNAL.
3. STUNT KEY CAUSES SUCCEEDING CHARACTER TO PERFORM A NON-PRINTING FUNCTION.

11-29-60

PROCESSING CODE SOMEWHAT IMPROVED FOR TELEPRINTER KEYBOARD

	000	001	010	011	100	101	110	111
0000	Null		ƀ	0	=	P		
0001			'	1	A	Q		
0010			"	2	B	R		
0011			$	3	C	S		
0100			%	4	D	T		
0101			&	5	E	U		
0110			*	6	F	V		
0111	C	C	-	7	G	W	C	C
1000			(	8	H	X		
1001			)	9	I	Y		
1010			:	x	J	Z		
1011			;	+	K	≤		
1100			?	/	L	≠		
1101			#	~	M	≥		
1110			,	↑	N	<		Esc.
1111			.	←	O	>		Del.

Developed at LosAngeles
on August 24, 1961